

DISCUSSION OF THE AMENDMENT

Due to the length of the specification herein, Applicants will cite to the paragraph number of the published patent application (PG Pub) of the present application, i.e., US 2002/0192549, when discussing the application description, rather than to page and line of the specification as filed.

Claim 21 has been amended by limiting M to Nb; by raising the minimum amount to --0.1-- at%, as supported by Example 1 in Table 2, at paragraph [0151] of the specification; by inserting the presence of γ -butyrolactone as a solvent, the concentration thereof in the solvent being 75 to 85% by volume, as supported at paragraph [0096] of the specification.

Claim 29 has been amended to depend on Claim 25.

Claims 18, 22, and 23 have been canceled.

New Claims 31-32 have been added, as supported at, for example, paragraph [0127] of the specification.

No new matter is believed to have been added by the above amendment. Claims 17, 21, and 24-32 are now pending in the application.

REMARKS

The rejection of Claims 18 and 21-25 under 35 U.S.C. § 102(b) as anticipated by JP 2000-138075 (JP '075), is respectfully traversed.

As recited in above-amended Claim 21, an embodiment of the present invention is a lithium secondary battery comprising a cathode, an anode and a polymer-based solid electrolyte in a solvent, wherein a lithium-containing composite oxide comprising lithium cobalt oxide and a subordinate component element M, wherein M is Nb, in an amount of 0.1 to 2 at% relative to cobalt in the lithium cobalt oxide, is a cathode active substance of the cathode, the solvent comprises γ -butyrolactone, and the concentration of γ -butyrolactone in the solvent is 75 to 85% by volume.

JP '075 discloses a nonaqueous electrolyte battery comprising, as a positive electrode material, a lithium containing composite oxide represented by the formula $\text{LiCo}_{1-x}\text{Nb}_x\text{O}_2$, wherein $0.00001 \leq x \leq 0.05$ [0007]. JP '075 further discloses a solvent for an electrolyte solution which contains ethylene carbonate and diethyl carbonate [0017].

JP '075 neither anticipates nor otherwise renders the present claims unpatentable. In the present claims, x is at least 0.1, which is twice the maximum of JP '075. Nor does JP '075 suggest the use of γ -butyrolactone as a solvent, let alone in an amount of 75 to 85% by volume. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claim 17 under 35 U.S.C. § 103(a) as unpatentable over JP '075 in view of either US 4,668,595 (Yoshino et al) or US 5,720,780 (Liu et al), is respectfully traversed. The Examiner relies on Yoshino et al and Liu et al for a disclosure of a polyvinylidene fluoride binder for a cathode. However, neither Yoshino et al nor Liu et al remedy the fundamental deficiencies in JP '075, discussed above. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 26-29 under 35 U.S.C. § 103(a) as unpatentable over JP '075, and further in view of Periasamy, "Studies on PVdF-based gel polymer electrolytes," Journal of Power Sources 88 (2000) 269-273 (Periasamy et al), is respectfully traversed. Periasamy et al is drawn to a gel polymer electrolyte using polyvinylidene fluoride, a plasticizer of 1:1 ethylene carbonate and propylene carbonate, and LiBF₄. However, Periasamy et al does not remedy the fundamental deficiencies in JP '075, discussed above. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claim 30 under 35 U.S.C. § 103(a) as unpatentable over JP '075 in view of Periasamy et al, and further in view of US 5,922,493 (Humphrey et al), is respectfully traversed. The Examiner relies on Humphrey et al's disclosure of PVDF homopolymer made by emulsion polymerization. Humphrey et al discloses that emulsion polymerization is preferably used because it results in a relatively pure polymer, but Humphrey et al neither discloses nor suggests that using such a PVDF homopolymer affects electrical properties, such as capacity, or the superior results obtained by the use of such PVDF homopolymer in combination with a γ -butyrolactone-containing solvent. Nevertheless, Humphrey et al does not remedy the fundamental deficiencies in the combination of JP '075 and Periasamy et al, discussed above. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 18 and 21-29 under 35 U.S.C. § 103(a) as unpatentable over Periasamy et al in view of JP '075, is respectfully traversed. The disclosures and deficiencies of both Periasamy et al and JP '075 have been discussed above. Neither reference remedies the deficiencies of the other. Thus, for example, neither reference discloses or suggests a LiCo_{1-x}Nb_xO₂, wherein the atomic amount of niobium Nb is at least 0.1 at%, or the improved results achieved thereby.

Compare, for example, the results in the specification at Table 2 for Example 1 compared to Examples 5 and 6, the only difference being the Nb content, wherein Example 1, which is within the terms of the present claims, has a specific capacity at -20°C of 20%, while Examples 5 and 6, which are outside the terms of the present claims, have a specific capacity of 12% and 16%, respectively, at -20°C.

Nor does the applied prior art disclose or suggest the improved 1C capacity results obtained with the presence of γ -butyrolactone in a solvent containing same in a predominant amount. Compare Example 1 with Examples 9 and 10, which are outside the terms of the present claims, as shown in Table 2 of the specification, the only difference being the amount of γ -butyrolactone, wherein the amount is 60% by volume in Example 9 and 95% by volume in Example 10, and 80% by volume in Example 1. The 1C capacity for Example 1 is 570 mAh while it is only 561 mAh and 565 mAh in Examples 9 and 10, respectively.

Neither reference recognizes the importance of the above-discussed characteristics of the presently-claimed invention.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The rejection of Claim 17 under 35 U.S.C. § 103(a) as unpatentable over Periasamy et al in view of JP '075, and further in view of either Yoshino et al or Liu et al, is respectfully traversed. Neither Yoshino et al nor Liu et al remedy the fundamental deficiencies in the combination of JP '075 and Periasamy et al, discussed above. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claim 30 under 35 U.S.C. § 103(a) as unpatentable over Periasamy et al in view of JP '075, and further in view of Humphrey et al, is respectfully traversed. Humphrey et al does not remedy the fundamental deficiencies in the combination of JP '075 and Periasamy et al, discussed above. Accordingly, it is respectfully requested that this rejection be withdrawn.

Applicants respectfully submit that all of the presently-pending claims in this application are now in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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